Globalisation, environmental change and health

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In recent decades we have seen how the expansion of human economic activities can have serious, large-scale and sometimes irreversible impacts on the environment. We have also begun to understand that these changes will affect the health of human populations. Meanwhile, we have seen increasing evidence of how the processes of economic globalisation (with its deregulated trade, mobility of capital, insecurity of employment, and erosion of labour standards) and the global spread of consumerism, ideology, electronic communication and human physical mobility are all having increasing impacts on human wellbeing and health - sometimes beneficially, often adversely. The unprecedented recent changes to the world's environment - its biophysical and ecological systems - are a central part of this narrative.

Our use of land, water, minerals and other natural resources has increased more than tenfold during the past century, as has our collective emission of greenhouse gases, like carbon dioxide, to the atmosphere. Future increases in population and economic development will intensify this pressure - at least until radical changes in technology and in consumption patterns are achieved. International agencies and national governments are beginning to take serious note of this global environmental decline. The tenor of the public debate is beginning to change, and globally networked NGOs are beginning to have influence. We need to supplement this new environmental awareness with an understanding of how human health depends fundamentally upon the sustaining of the biosphere's ecosystems and other environmental resources.

With the onrush of modern urban societies and technically proficient health-care systems, we have lost sight of the wellsprings of population health. The health of a population depends on a range of influences - social, economic, behavioural and environmental. In the longer term, however, the most fundamental need is for a life-supporting environment - a human habitat based on intact ecosystems that provide clean air, safe water, adequate food, tolerable temperature, a stable climatic pattern, protection from solar ultraviolet radiation, and sustained biodiversity.

Socio-economic change, public health initiatives and, to a lesser extent, gains in medical care, have continued to improve our basic health indices in recent decades. Average life expectancy doubled during the twentieth century. Infant and child mortality has declined strongly in many poorer countries, as have birth rates. Nevertheless, there are still great and inequitable disparities in health status around the world, and a tragic setback has emerged in Sub-Saharan Africa where HIV/AIDS has trimmed a decade or more off life expectancy in many countries.

We have begun to understand that short-term economic development can impair public health if environmental and social considerations are marginalised. Development directed at rapid economic "growth" has created a trail of environmental damage and urban-fringe hardship. On the margins of the modern world are various minority, traditionally-living, ethnic groups whose living space, livelihood and health has been adversely affected by the encroachment of logging, deforestation, oil exploration, dam-building and gold prospecting. More generally the sorts of health hazards that can be unleashed by unwise environmental intervention are illustrated by the now-massive problem of arsenic toxicity in Bangladesh and East Bengal, where millions of deep tubewells have been drilled to secure alternative freshwater in response to the pressures of population, poverty and lack of hygiene.

Global Change and Human Health serves to communicate scientific understanding of important linkages between global economic activities, environmental changes and human population health. Some scientific processes are well recognised and call for strategic policies; others demand new insights from directed research. This new journal provides a forum for both, and should assist both scientists and policy-makers to obtain current knowledge from credible sources.

Globalisation and environmental change: the larger dimension

There is a much larger dimension to this topic. Beyond the surge of modern population growth and rising prosperity looms the daunting realisation that we have begun to live beyond Earth's means. In 1998 the WorldWide Fund for Nature estimated, from a global environmental inventory, that we have lost almost one-third of the planet's "vitality" - its functioning ecosystems - since 1970. Listen to the words of the UN Environment Programme, written in September 1999:

"The beginning of a new millennium finds the planet Earth poised between two conflicting trends. A wasteful and invasive consumer society, coupled with continued population growth, is threatening to destroy the resources on which human life is based. At the same time, society is locked in a struggle against time to reverse these trends and introduce sustainable practices that will ensure the welfare of future generations...

"Now time for a rational, well-planned transition to a sustainable system is running out fast. In some areas, it has already run out: there is no doubt that it is too late to make an easy transition to sustainability for many of these issues..."

Scientists foresee a range of adverse health consequences from these massive changes in the global environment, these signs that we are exceeding the planet's carrying capacity. Much recent attention has been paid to the health impacts of global climate change. Other examples result from the increasing pressures on land and food production, precipitating the sort of conflict that has occurred recently in environmentally stressed parts of Sub-Saharan Africa - such as in Rwanda in the early 1990s and, subsequently, in neighbouring Burundi.

Global Change and Human Health seeks to extend our field of vision towards a fuller understanding of the health consequences. There is a basic paradox in the contemporary situation: life expectancies are continuing to rise but the continued disruption and impoverishment of the biosphere are likely to weaken Earth's life-supporting capacity - and will therefore jeopardise human health. This will require some re-thinking, some imagination. Our models of health and disease, in western societies, are embedded in mechanistic Newtonian

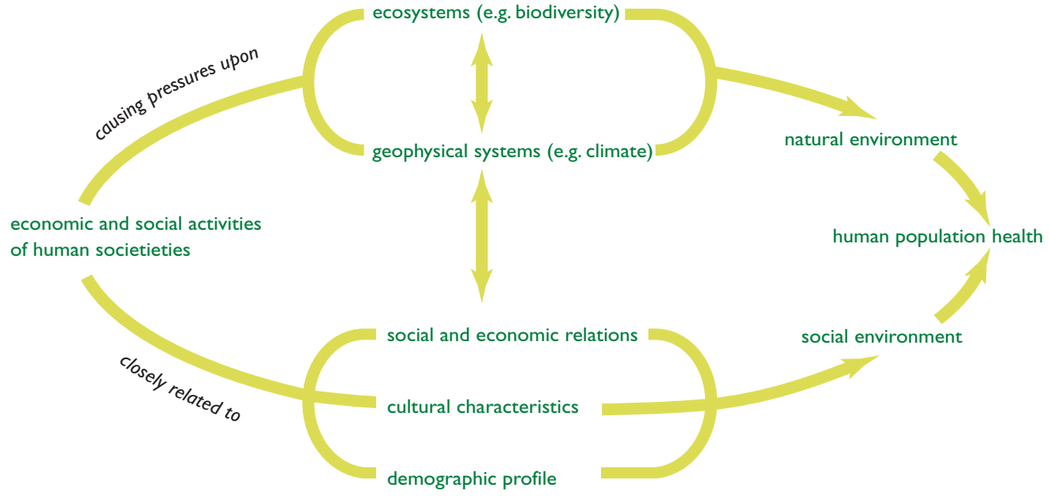

Figure 1 *Health as an important integrating index that reflects the state of natural and socioeconomic environments*

science - the science of disaggregation, quantification and assumed orderliness, the science that assumes that a germ, toxin, dietary indiscretion or gene can account for most diseases. However, there are time-lags between many types of adverse environmental change and their impacts on health, and human societies can often adapt to adverse conditions with technological innovations. We need to stand back and acquire a bigger picture, to recognise that the health of human populations is as an expression of their socioeconomic and ecological circumstances.

These contentious matters cannot be resolved by speculation. The tasks for the health scientist are several: to elucidate the relationships between environmental conditions and health outcomes, to seek early evidence of health trends in response to environmental change, and to provide sound projections of likely outcomes of future scenarios of environmental change.

The main types of global change

In this journal, "global change" processes encompass a broad sweep of social, economic, demographic and environmental changes. To date, most attention has been paid to some of the (relatively) more straightforward hazards posed by global environmental changes - such as climate change and stratospheric ozone depletion, and loss of biodiversity - of a kind that were not on the agenda a short quarter-century ago.

Box The main global environmental changes - of a kind that were not on the agenda a short quarter-century ago.

Climate change

The majority climate scientists agree that the continued accumulation of heat trapping "greenhouse gases" in the lower atmosphere will change the global patterns of temperature, precipitation and climatic variability. The anticipated globally-averaged rise of 1-2°C over the coming half-century, greater at high than at low latitudes, would represent a very fast rate of increase.

Throughout the 1990s, scientists gave increasing attention to assessing the potential health consequences of climate change. Risks to human health will arise from increased exposures to thermal extremes and from increases in weather disasters. Substantial other risks would arise because of climate-induced changes in complex ecological systems that influence the geography of insect-borne infections (such as malaria, dengue fever and leishmaniasis), the range, seasonality and incidence of various food-borne and water-borne infections, agricultural crop yields, the range of plant and livestock pests and pathogens, and the salination of coastal lands and freshwater supplies due to sea-level rise. Some benefits may also occur, such as reduced winter mortality in temperate countries, or a decline in some infectious diseases that are intolerant of heat.

Stratospheric ozone depletion

Depletion of stratospheric ozone by human-made industrial gases such as chlorofluorocarbons (CFCs) has now been documented over several decades. Terrestrial levels of ultraviolet irradiation are estimated to have increased by around 10% at mid-to-high latitudes since 1980. This loss of ozone, and increased radiation exposure, is likely to peak by around 2010-2020. The consequences for human health include a certain excess of skin cancers, and perhaps deleterious effects on eyes and immune system functioning. There will also be adverse effects on crop growth, other vegetation, marine phytoplankton (the "grass" of the oceans), and various egg-laying aquatic species.

These changes in the lower and middle atmospheres provide the most unambiguous, scientifically documented, signal yet that the enormous aggregate impact of humankind has begun to overload the biosphere. We have exceeded the capacity of the atmosphere to act as "sink" for our gaseous wastes.

Loss of biodiversity

As the human demand for space, materials and food increases, so populations and species of plants and animals around the world are being extinguished at an accelerating rate - apparently much faster than the five great natural extinctions that have occurred in the past half-billion years since vertebrate life evolved. Deforestation, currently proceeding at a rate of 2.5 acres per second, is partly responsible. The problem is not simply the loss of valued items from nature's catalogue; it is, more seriously, the destabilisation and weakening of whole ecosystems and the subsequent loss of their products and their recycling, cleansing and restorative services. We are losing, prior to their discovery, many of nature's chemicals and genes - of the kind that have already conferred enormous medical and health improvement benefits.

Meanwhile, "invasive" species are spreading into new non-natural environments via intensified human food production, commerce and mobility. These changes in regional species composition have myriad consequences for human health. Just one example: the choking spread of water hyacinth in eastern Africa's Lake Victoria, introduced from Brazil as a decorative plant, has provided a micro-environment that facilitates the proliferation of diarrhoeal disease bacteria and the water snails that transmit schistosomiasis.

Nitrogen loading

There has been a remarkable, sixfold, increase in the human "fixation" of biologically activated nitrogen since the commercialisation of nitrogenous fertilisers in the 1940s. Humans now produce more activated nitrogen than does the biosphere at large. This disruption of the biosphere's nitrogen cycle may soon turn out to be as serious a problem as the better-known disruption of the world's carbon cycle. This nitrogen loading is affecting the acidity and nutrient balances of the world's soils and waterways, and this affects plant biochemistry, the pattern of plant pests and pathogens, and the species composition of ecosystems. Nitrogen-induced eutrophication of waterways, leading to algal blooms and oxygen depletion, is beginning to adversely affect coastal waters, such as the Chesapeake Bay, the Baltic Sea and the Gulf of Mexico.

Terrestrial and marine food-producing systems

Meanwhile, the ever-increasing demands of agricultural and livestock production are adding further stresses to the world's arable lands and pastures. We enter the twenty-first century with an estimated one-third of the world's previously productive land seriously damaged by erosion, compaction, salination, waterlogging or chemicalised destruction of organic content. Similar pressures on the world's ocean fisheries have left many of them seriously depleted. These changes compromise the capacity of the world to continue to provide, sustainably, sufficient food for humankind.

Freshwater supplies

Freshwater aquifers are being depleted of their water stores in all continents. Agricultural and industrial demand now often greatly exceeds the rate of natural recharge. Water shortages are likely to cause tensions and conflict over coming decades. For example, Ethiopia and the Sudan, upstream of Nile-dependent Egypt, increasingly need the Nile's water for their own crop irrigation. Around the world, many other river systems are shared uneasily between neighbours in unstable regions: including the Ganges, the Mekong, the Jordan, and the Tigris and Euphrates rivers. Approximately 40% of the world's population, living in 80 countries, now faces some level of water shortage. India has seen its per-person supply of freshwater drop from 5500 cubic metres per year in the 1950s to around 1800 cubic metres now, hovering just above the official scarcity threshold.

Persistent organic pollutants

Many long-lived and biologically active chemicals have become widely distributed across the globe. Lead and other heavy metals are present at increasing concentrations in remote environments. More worrying, various semi-volatile organic chemical pollutants (such as PCBs) are disseminated towards the poles via a remarkable sequential "distillation" process through the cells of the lower atmosphere. Consequently, their concentrations are increasing in polar mammals and fish and in traditional human groups that eat them. Their immunosuppressive effect has been demonstrated in seals and other marine mammals. Current epidemiological studies in the Faroe Islands and elsewhere may soon tell us if humans are similarly affected.

tion. The journal will therefore carry articles about the health consequences and policy implications of the several main types of environmental change (see accompanying box). The journal will also explore the origins and population health consequences of large-scale social, economic, cultural and political changes. Indeed, there are many intimate connections between those processes and global environmental change - such as the loss of biodiversity caused by unregulated deforestation, seabed trawling and net-fishing; the extraordinary 40-year-long persistence of the current cholera pandemic in the urban slums of the South; the degradation of land as traditional farmers are displaced onto marginal land by cash-cropping plantation agriculture; and the excessive production and use of ozone-destroying gases by low-income countries seeking to slow the widening of the wealth gap.

Conclusion

Today's unprecedented worldwide processes of social-economic, demographic and global environmental change oblige us to broaden our ideas about the determinants of health. The loss of natural environmental capital is impairing the biosphere's capacity to sustain the healthy human populations. The loss of social capital and the increase in socioeconomic inequality within many communities is also adversely affecting their prospects for health.

There are many new challenges in all of this for the health scientist. The empiricism at the heart of science requires that, wherever possible, we study current or historical sets of observations. And yet many of the questions that now press upon us refer to impending future risks. We cannot foresee the future. But we can link it to the present and we can make plausible models of it.

Population health must move to centre-stage, as a primary criterion of how well, how sustainable, we are managing our living space. Scientists and policy-makers face some unfamiliar challenges in addressing these broader contextual issues in population health. We need a broader ecological perspective to inform our ideas about human health and disease. *Global Change and Human Health* will strive to promote that discussion, as we fumble our collective way towards a sustainable world.

P. Martens, A.J. McMichael, J. A. Patz